

Survey and alignment of the synchrotron SIS18

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To fulfil the intensity requirement of the GSI Facility as well as projects and conceptions of the future facility of FAIR, a number of high precise geometrical 3D measurements as well as conceptual work have been carried out during the past year. Responsible for these activities was the survey and alignment (S&A) group of GSI, which is assigned to the project division *Engineering* within *FAIR@GSI*. The S&A team is involved in many projects like i.e. CryRing, EMTEX, SIS100 “first-of-series”(FOS) dipole and others for the different FAIR and GSI machines. This short report focusses on the realignment of the SIS18 synchrotron, which was carried out completely in one go, what was never done since the first installation.

A low grade of quality of the circling beam in the SIS18 made the commissioning in February 2014, after a 1 year lasting shutdown period, very difficult. This fact and the hypothesis that the construction activities for the future FAIR facilities, including piling and lowering the ground water level, will have an impact in the current position of the machine, lead to a total survey of the actual position of all SIS18 magnets, BPM and adjacent machine parts by 3D measurements.

Measuring the 3D point network, a Laser Tracker and a level instrument were used. The surveying of SIS18 was carried out within four days. All fiducials on the components just like the temporary points on the wall and pillars as well as the Laser Tracker stations were included in the network adjustment. Parts of the transfer line to the synchrotron (TK) as well as the HEBT area behind the SIS18 were surveyed in order to supervise these transit areas of the beam. The accuracy of the network points after the free adjustment, which was done to define the inner geometry of the network (minimal constraints), was between 0.02mm to 0.05mm in all three directions. For the geodetic datum only the fiducials on the dipoles were used. After the final adjustment calculation it turned out that the new coordinates had a huge variation regarding to the nominal coordinates. The relative deviation between the components in the lateral and in the vertical position was up to 4mm and 5mm respectively [1].

A major realignment of the whole area was needed from the analyses of the results.

All components of the SIS18 should be aligned, as well as four quadrupoles in TK9 area. The TASA-point system requires for alignment the use of a Laser Tracker to measure the two fiducial points on the magnets together with inclinometers that are needed to determine the precise lateral inclination of the components. In contrast to the magnets BPM chambers have up to now no fiducial points with a precise reference to the internals. Thus, the

specified actual position of BPM internals and their alignment was based on assumptions.

The alignment tolerances for magnets and BPM in lateral and vertical direction were defined as better than 0.2mm; in a few cases up to 0.5mm was acceptable. The remaining lateral tilt after alignment should not exceed 0.1mrad.

Some problems appeared during the alignment which was relative with the number of the adjustment feet of the components. It was confirmed again that the alignment of a three-feet-component is much friendlier and faster compared to a component with four feet.

With few exceptions - caused by mechanical reasons - all magnets could be aligned within tolerance (fig. 1, 2). The complete alignment was carried out within four weeks.

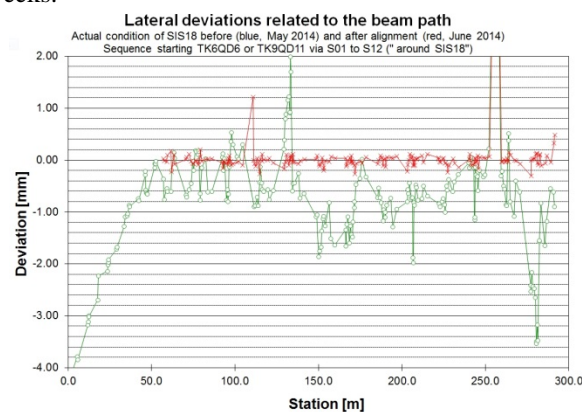


Figure 1: Beam plot for synchrotron SIS18. Lateral deviation before (green) and after (red) alignment

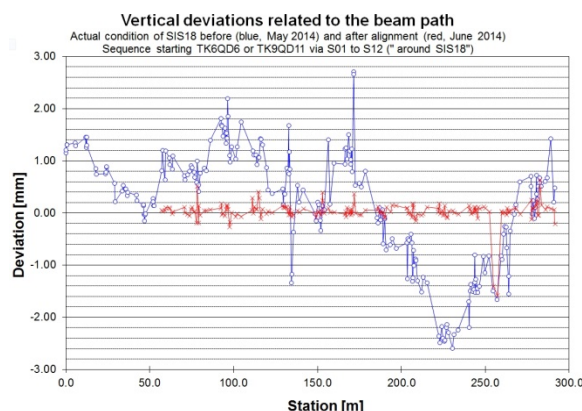


Figure 2: Beam plot for synchrotron SIS18. Vertical deviation before (blue) and after (red) alignment

References

- [1] I. Pschorn, T. Miertsch, K. Knappmeier, V Velonas, „SIS18 Netz und Justage – interne Reports“

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